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Comparative study of physico-chemical properties of soil under different canopies in Jhansi

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Abstract

Soil properties and different land use system based on the result of study, variation in soil physico-chemical properties were observed. This variation in soil physico-chemical properties could be related to accumulation of organic matter due to leaf litter, frequent tillage properties, crop residues during harvesting process and use of organic manures etc. It is therefore recommended that appropriate and integrated land management options for different land use systems are required to sustain Agricultural productivity with indulgence of trees to maintain environment and ecological balance as well. The information generated from the present study can lead to development of sustainable and ecologically stable land use system for Jhansi district of Bundelkhand region.

Keywords: Physico-Chemical, Jhansi, Canopies

Introduction

Soil is a mixture of minerals, organic matter, gases, liquids, and countless organisms that together support life on Earth. Soil is a natural body called the pedosphere which has four important functions: it is a medium for plant growth; it is a means of water storage, supply and purification; it is a modifier of Earth's atmosphere; it is a habitat for organisms; all of which, in turn, modify the soil. Plant uptake of nutrients can only proceed when they are present in a plant-available form. In most situations, nutrients are absorbed in an ionic form from (or together with) soil water. Although minerals are the origin of most nutrients, and the bulk of most nutrient elements in the soil is held in crystalline form within primary and secondary minerals, they weather too slowly to support rapid plant growth. For example, The application of finely ground minerals, feldspar and apatite, to soil seldom provides the necessary amounts of potassium and phosphorus at a rate sufficient for good plant growth, as most of the nutrients remain bound in the crystals of those minerals.¹⁻²

A soil's physical and chemical properties affect plant growth and soil management. Some important physical and chemical properties of soil are mineral content, texture, cation exchange capacity, bulk density, structure, porosity, organic matter content, carbon-to-nitrogen ratio, color, depth, fertility, and pH.³

The study of the chemical and physical properties of soil helps in managing resources while working with a particular kind of soil. Not all soils have similar properties, and working with them requires understanding soil properties in detail. Understanding the chemical and physical properties of soil means understanding the soil behavior under different temperature and pressure conditions. Soil mass is always subjected to changing temperature and pressure forces and, depending upon the chemical and physical properties of the soil mass, the necessary actions will be taken. For agricultural and construction purposes, soil properties need to be studied to increase the productivity of soil and to improve the workability of the soil mass, so knowing soil behavior inside out is very important.⁴⁻⁵ Thus considering the enormous importance of soil for life. The present investigation was carried out to examine how soil properties viz. Physical, chemical and biological properties behave under different canopies viz. tree, crop, agroforestry system and open canopy were affected.

Thus the present study entitled "comparative study of physico-chemical properties of soil under different canopies in Jhansi" was undertaken with the following objectives-

1. To compare the effect of different vegetation covers on physical and chemical properties of soil.

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- To compare the physical and chemical properties of soil with increasing depth vertically.

Material and Methods

Study area

Jhansi is a historic city in the Indian state of Uttar Pradesh. It lies in the region of Bundelkhand on the banks of the Pahuj River, in the extreme south of Uttar Pradesh. Jhansi is the administrative headquarters of Jhansi district and Jhansi division. Called the *Gateway to Bundelkhand*, Jhansi is situated between the rivers Pahuj and Betwa at an average elevation of 285 metres (935 feet). It is about 415 kilometres (258 mi) from New Delhi and 99 kilometres (62 mi) south of Gwalior.

Selected Sites

The experimental work entitled "Comparative study of physico chemical properties of soil under different canopies in Jhansi" was carried out in organic farm of institute of agricultural sciences located at Karguanji village behind Bundelkhand from Feb 2017 to May 2017. The following covers were selected for collection of soil sample.

For the study of Assessment of soil physical and chemical properties under different canopy covers in District Jhansi following covers are selected:

- Agroforestry Tree crop (denoted by Af) : Agroforestry system consisting/comprising in the research were Arjun and Chilli.
- Tree (denoted by Tr) : Plantation of Arjun Tree
- Crop (denoted by Cr) : Pigeon pea
- Barren Land (denoted by B)

Analytical Procedures⁶⁻⁸

Physical Analysis of Soil

Mechanical Analysis

It was done by international pipette methods as described.

pH: It was measured in 1:2.5 soil water suspension by Elico Digital pH meter.

EC: It was measured in the above soil suspension by conductivity meter as described.

Cation Exchange capacity: It was determined according to the method as outlined.

Determination of soil pH

pH is defined as the logarithm to the base of 10 of the inverse of the hydrogen ion concentration (or preferably H^+ ion activity). It is also the negative logarithmic to the base of H^+ activity. It was determined by Blackman's pH meter

Procedure

Taken 10 g of the soil and added 25 ml distilled water. Shaken and after 30 minutes, dipped both the

glass electrodes and the calomel electrode in the soil suspension. Connected the electrode to the pH meter which has already been checked with a standard buffer of known pH. Switched on the current and increased or decreased resistance in the external circuit so that potential of the electric power equalises the potential of the cell containing soil suspension and the galvanometer needle stands at zero. The pH of the soil was noted from the scale.

Measurement of electrical conductivity (EC)

Since ions are the carrier of electricity, the electrical conductivity (EC) of the soil-water system rises accordingly to the content of soluble salts in the soil giving rise to more of ion pairs on dissociations as it happens in case of a dilute solution. Thus, the measurement of EC can be directly related to the soluble salts concentration of the soil at any particular temperature.

Instrument

The apparatus for measuring electrical conductivity consists of an AC salt bridge or electrical resistance bridge and conductivity cell having electrodes coated with platinum black. The instrument is also available as an already calibrated assembly for giving directly the conductivity of solutions in mmhos per cm at 25°C.

Reagents

Standard potassium chloride (KCl) solution: 0.7456 g of dry reagent grade potassium chloride was dissolved in freshly prepared double distilled water and made to one liter. At 25°C gives an electrical conductivity of 1411.8×10^{-6} (0.0014118) mmhos/cm or 1.41 mmhos/cm. The conductivity bridge was calibrated and cell constant determined with the help of this solution. Even if the scale is marked directly in mmhos/cm it is necessary to check and calibrate the instrument with the KCl solution.

Procedure

Shaken 20 g of soil with 40 ml of distilled water in a 150 ml conical flask for one hour and allowed to stand. Alternatively, the clear extract after pH determination was used for electrical conductivity measurement. The conductivity of the supernatant liquid was determined with the help of the salt (conductivity) bridge. The measurement of EC (expressed in mmhos/cm) was adjusted at 25°C of the solution by setting the knob provided for this purpose.

Available Boron

It was determined by the method of Berger and Trog.

Available DTPA extractable Zn in soil

Available zinc content will be extracted with 0.005 M DTPA, 0.01 M CaCl₂ and 0.1 M Triethanol amine (TEA) adjusted to pH 7.3 and analysed pn atomic absorption spectrophotometer.

Available Sulphur, Iron and Manganese

It was determined by the method of Berger and Trog.

Results and Discussion

In order to better understand the impact of different covers on soil properties, present investigation entitled “Comparative study of physic chemical properties of soil under different canopies in Jhansi.” was carried out.

Physical properties of soils viz., pH, EC under different Canopy viz., Af, Tr, Cr, and B were analyzed and noted very negligible differences in physical properties.

Physico-chemical properties of soil under different canopies

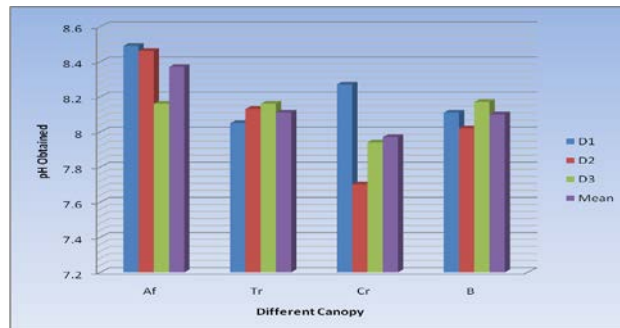
The soil was analyzed for the physical and chemical parameters under different canopies viz., Agroforestry system, Tree, Crop and Barren land In this various parameters viz., pH, EC, and some micronutrients such as S, Zn, B and Mn were determined.

The pH of soil was determined under different canopies at the farm and was found to be maximum 8.49 for D₁ (10 cm) under agroforestry and minimum 7.70 for (D₂ 20 cm) under Crop (Table 1 and Graph 1). Maximum average pH 8.37 was recorded in Agroforestry while minimum average pH 7.97 was recorded in case of Crop cover. The detailed pH for all the selected parameters were presented in Table 1 and shown in Graph 1.

Table 1: pH of Soil under different canopy in Jhansi district

S/No.	Depth	Af	Tr	Cr	B	Mean
1.	D ₁	8.49	8.05	8.27	8.11	8.23
2.	D ₂	8.46	8.13	7.70	8.02	8.07
3.	D ₃	8.16	8.16	7.94	8.17	8.11
4.	Mean	8.37	8.11	7.97	8.10	

Values are expressed as Mean, n=3



Graph 1: pH of Soil under different canopies in Jhansi district

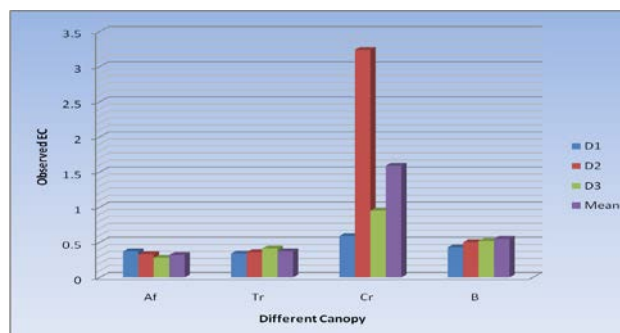
Electrical conductivity of all the soil samples was between 0 to 0.6 /ums.

The EC of soil was determined under different canopies in Jhansi district of Bundelkhand region and was found to be maximum 3.24 for D₂ under Cr and minimum 0.28 for D₃ under Agroforestry (Table 2 and Graph 2). Maximum average EC 1.59 was recorded in Cr while minimum average EC 0.32 was recorded in Af. The detailed EC for all the selected parameters were presented in Table 2 and shown in Graph 2. The findings of the current study seem to be in agreement with Bhojvaiv that conducted a research on reclaiming sodic soils for wheat production by *Prosopis juliflora* and found increased soil EC under *P. juliflora* as compared to that of the non sodic farm soil in India.

Table 2: EC of Soil under different canopies in Jhansi district

S/No.	Depth	Af	Tr	Cr	B	Mean
1.	D ₁	0.37	0.34	0.59	0.43	0.48
2.	D ₂	0.33	0.36	3.24	0.50	1.10
3.	D ₃	0.28	0.41	0.95	0.52	0.54
4.	Mean	0.32	0.37	1.59	0.55	

Values are expressed as Mean, n=3



Graph 2: EC of Soil under different canopies in Jhansi district

Sulphur is very important part of the proteins needed to sustain life in all biological organisms, The

Sulphur content, Zinc, Iron, Boron and Manganese of soil were also determined under different canopies viz, Af, Tr, Cr & B. Maximum average Sulphur content 12.86 was recorded in Tr while minimum average 7.93 was recorded in Cr. The detailed Sulphur content for all the selected parameters were presented in Table 3 and shown in Graph 3.

The Zinc content of soil was determined under different canopies in Jhansi district of Budelkhand region and was found to be maximum 0.90 for D₂ in Af system and minimum 0.35 for D₃ under D r barren land (Table 4 and Graph 4). Maximum average Zinc content 0.73 was recorded in Af while minimum average 0.43 was recorded in B. whereas tree canopy gave an average value of 0.56 was recorded under crop canopy .In case of value of zinc first there is increase then decrease with increasing depth . The detailed zinc content for all the selected parameters were presented in Table 4 and shown in Graph 4.

The Iron content of soil was determined under different canopies in Jhansi district of Budelkhand region and was found to be maximum 14.28 for D₂ in B and minimum 5.30 for D₁ in Af (Table 5 and Graph 5). Maximum average Iron content 9.95 was recorded under barren land. While minimum average 6.37 was recorded in Af. Whereas tree canopy recorded an average value of 8.05 in comparison to value of 7.18 under crop canopy .With increasing depth there was observed increase in iron content than a decrease .The detailed iron content for all the selected parameters were presented in Table 5 and shown in Graph 5.

The Boron content of soil was determined under different canopies was recorded and found to be maximum 0.92 for D₁ in Crop and minimum 0.28 for D₂ under barren land . (Table 6 and Graph 6). Maximum average Boron content 0.54 was recorded in Cr while minimum average 0.33 was recorded under barren land. Average value of 0.44 & 0.38 were recorded under the canopy of agroforestry system & tree respectively. In case of agroforestry system maximum value 0.47 was found under D₂ depth followed by 0.45 & 0.40 at D₁ & D₃ depths respectively. Whereas under the canopy of tree crop & barren land the maximum value was recorded under D₁ depth followed by D₃ and D₂ respectively. The detailed boron content for all the selected parameters were presented in Table 6 and shown in Graph 6.

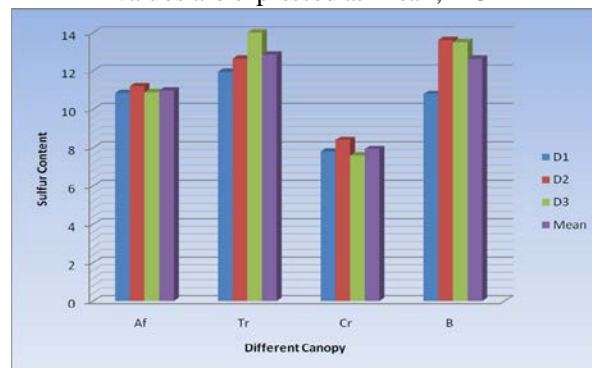
The Manganese content of soil was determined under different canopies was found to be maximum 8.71 for D₂ under Tree and minimum 4.32 for D₁ under Crop (Table 7 and Graph 7). Maximum average

Manganese content 7.97 was recorded under Tree while minimum average 3.96 was recorded under Crop. While under agroforestry canopy average Mn content 4.40 Agroforestry system & under Barren land 5.27 were recorded respectively. The highest value 4.61 was observed at D₃ depth followed by 4.30 & 4.29 at D₂ & D₁ depth respectively. Hence, increase in Manganese was observed with increasing depth . However under the canopy of Crop maximum value was observed at D₃ depth followed by D₄ & D₁ depth respectively. The detailed Manganese content for all the selected parameters were presented in Table 7 and shown in Graph 7.

Table 3: Sulphur content of Soil under different canopies in Jhansi district

S/No .	Depth	Af	Tr	Cr	B	Mean
1.	D ₁	10.86	11.96	7.8	10.8	10.35
2.	D ₂	11.20	12.63	8.4	13.6	11.45
3.	D ₃	10.90	14.0	7.6	13.5	11.5
4.	Mean	10.98	12.86	7.93	12.63	

Values are expressed as Mean, n=3

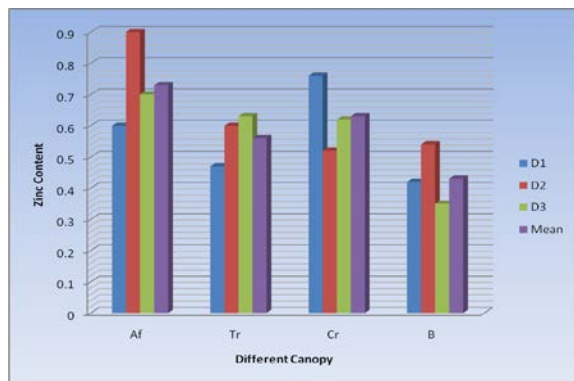


Graph 3: Sulphur content of Soil under different canopies in Jhansi district

Table 4: Zinc content of Soil under different canopies in Jhansi district

S/No.	Depth	Af	Tr	Cr	B	Mean
1.	D ₁	0.60	0.47	0.76	0.42	0.56
2.	D ₂	0.90	0.60	0.52	0.54	0.64
3.	D ₃	0.70	0.63	0.62	0.35	0.57
4.	Mean	0.73	0.56	0.63	0.43	

Values are expressed as Mean, n=3

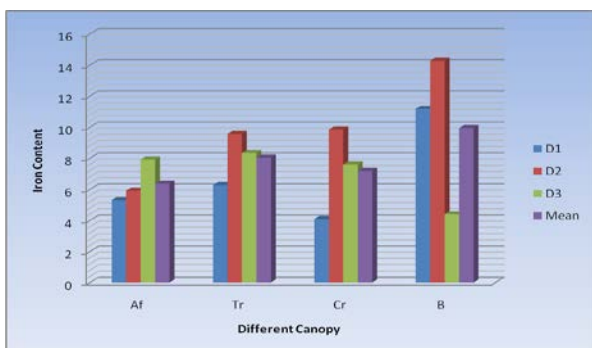


Graph 4: Zinc content of Soil under different canopies in Jhansi district

Table 5: Iron content of Soil under different canopies in Jhansi district

S/No.	Depth	Af	Tr	Cr	B	Mean
1.	D ₁	5.30	6.27	4.10	11.18	6.71
2.	D ₂	5.91	9.56	9.85	14.28	9.90
3.	D ₃	7.92	8.34	7.60	4.40	7.06
4.	Mean	6.37	8.05	7.18	9.95	

Values are expressed as Mean, n=3

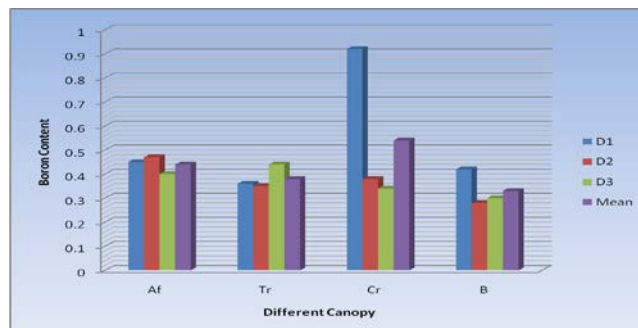


Graph 5: Iron content of Soil under different canopies in Jhansi district

Table 6: Boron content of Soil under different canopies in Jhansi district

S/No.	Depth	Af	Tr	Cr	B	Mean
1.	D ₁	0.45	0.36	0.92	0.42	0.53
2.	D ₂	0.47	0.35	0.38	0.28	0.37
3.	D ₃	0.40	0.44	0.34	0.30	0.37
4.	Mean	0.44	0.38	0.54	0.33	

Values are expressed as Mean, n=3

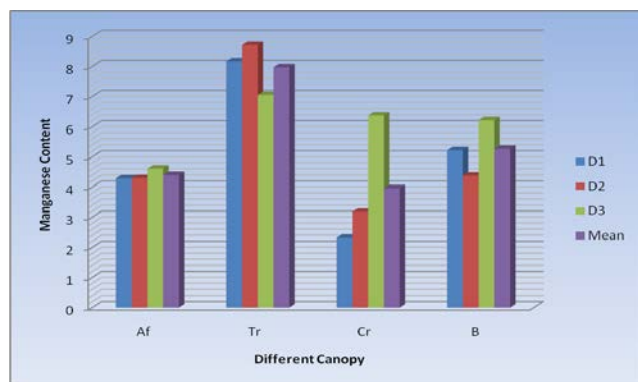


Graph 6: Boron content of Soil under different canopies in Jhansi district

Table 7: Manganese content of Soil under different canopies in Jhansi district

S/No.	Depth	Af	Tr	Cr	B	Mean
1.	D ₁	4.29	8.17	2.32	5.22	5.0
2.	D ₂	4.30	8.71	3.18	4.38	5.14
3.	D ₃	4.61	7.05	6.38	6.22	6.06
4.	Mean	4.40	7.97	3.96	5.27	

Values are expressed as Mean, n=3



Graph 7: Manganese content of Soil under different canopies in Jhansi district

Conclusion

The study entitled “Comparative study of physico chemical properties of soil under different canopies in Jhansi” was carried out and the following points could be summarized.

- The result revealed that the P^H was found maximum at a depth of 0-10 cm. Agroforestry system followed by sole crop system and minimum was recorded in sole crop at a depth of 10-20 cm.
- The EC was found to be maximum at a depth of 10-20 cm. under sole crop and minimum under agroforestry system at 20-30 cm.
- The Sulphur content of soil was found to be maximum under the tree depth between 20-30

cm. and minimum was recorded under sole crop at 20-30 cm. depth.

- The value of Zinc was observed maximum under agroforestry system at a depth of 10-20 cm. and minimum was recorded under barren land at a depth of 20-30 cm.
- Observed value of Iron was recorded maximum under the canopy of barren land at a depth of 10-20 cm. and minimum under agroforestry system at a depth of 0-10 cm.
- The Boron content was observed maximum under the canopy of crop at 0-10 cm. depth and minimum at 10-20 cm. depth under barren land.
- The Manganese content was observed under different under soil classes found to be maximum at 10-20 cm. depth under tree and minimum at 0-10 cm. depth under crop.

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